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Q No : 1

Given data:-

Dead compression load = 60K
live compression load = 110 K
$K_x L_x$ = 36ft
$K_y L_y$ = 18ft

Column is supported "pin" at the top and bottom in both direction.

Using AISC/LRFD method

Sol:-

Required capacity = (1.2 x60)+(1.6 x110)
= 248 K

Enter design strength table of material with K_L = 18ft and P = 248K.

Some possible sections are ;

$W_{14} \times 61$	P = 364K	$r_x/r_y = 2.44$
$W_{12} \times 53$	P = 320K	$r_x/r_y = 2.11$
$W_{10} \times 49$	P = 301 K	$r_x/r_y = 1.71$
$W_8 \times 58$	P = 300K	$r_x/r_y = 1.74$

Now;

$$K_x l_x / K_y l_y = \frac{36}{18} = 2$$

Scanned with CamScanner

Try ; $W_{12} \times 53$ $\quad r_x/r_y = 2.11$

$$r_x/r_y > \frac{K_x l_x}{K_y l_y}$$

$r_x = 5.23$, $r_y = 2.48$, $A = 15.6\,in^2$

$$K_x l_x / r_x = \frac{36 \times 12}{5.23} = 82.6$$

$$K_y l_y / r_y = \frac{18 \times 12}{2.48} = 87.09$$

$$KL/r = 87.09$$

$$\lambda_c = \frac{KL}{r\pi} \sqrt{F_y/E}$$

$$= \frac{87.09}{\pi} \sqrt{36/29{,}000}$$

$$= 0.97 < 1.5$$

Now;

$$F_{cr} = 0.658^{\lambda_c^2} \times F_y$$

$$= (0.658)^{(0.97)^2} \times 36$$

$$F_{cr} = 24.28$$

$P_n = A_g F_{cr}.$

$P_n = 15.6 \times 24.28$

$P_n = 378.78\ K.$

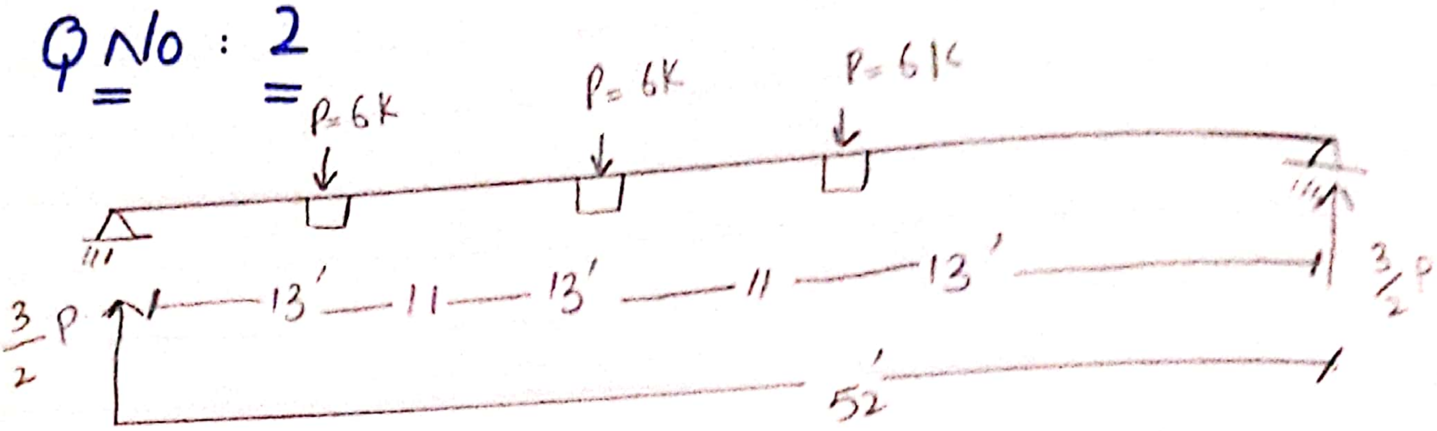
$\phi P_n = 0.85 \times 378.78$

$= 321.96 > 248\ K$

So use ; $W_{12} \times 53$.

Required. W-shaped column.

Q No : 2



→ Lightest W-section.

→ D.L = 1.5k L.L = 4.5k.

(At eachother quarter point).

→ Total length = 52'

→ Live load deflection = $\frac{1}{360}$ of span
Δ_{lim}

→ $F_y = 36 ksi$

Using AISC/ASD method.

Sol:-

Design load = 4.5 + 1.5 = 6 k.

P = 6 k.

$$\Delta = \frac{5}{48} \frac{ML^2}{EI} \rightarrow (1)$$

Δ by this equation is multiplied by the factor ~~given~~

$$M = \left(\frac{3}{2} \times 6 \times 26\right) - \left(6 \times 13\right) = 156 k.ft$$

$$eq\ (1) \Rightarrow I = \frac{5}{48} \times \frac{ML^2}{E\Delta} \times 0.95$$

$$I = \frac{5}{48} \frac{(156 \times 12)(52 \times 12)^2}{29{,}000\left(\frac{52}{360} \times 12\right)}$$

$$I = 1510.51\ in^4$$

Try $W_{24} \times 62$: $I_x = 1550\ in^4$

$b_f = 7.04\ in$, $d/A_f = 5.72$

$$L_c = \frac{76 b_f}{\sqrt{F_y}} \Rightarrow \frac{76 \times (7.04)}{\sqrt{36}} = 84'' = 7.41'$$

$$L_c = \frac{20{,}000}{f_y \frac{d}{A_f}} \Rightarrow \frac{20{,}000}{36 \times 5.72} = 97.12'' = 8.09'$$

$L > L_c$ as $C_b = 1.13$

$$\sqrt{\frac{102{,}000\, C_b}{F_y}} \Rightarrow \sqrt{\frac{102{,}000 \times 1.13}{36}} = 57$$

$$\sqrt{\frac{510{,}000\, C_b}{F_y}} \Rightarrow \sqrt{\frac{510{,}000 \times 1.13}{36}} = 91.27$$

$$\frac{L}{r_T} = \frac{13 \times 12}{1.71} = 91.22$$

Condition ;

$$\sqrt{\frac{102{,}000\,C_b}{F_y}} \le \frac{L}{r_T} \le \sqrt{\frac{510{,}000\,C_b}{F_y}}$$

So ;

$$F_b = \left[\frac{2}{3} - \frac{F_y (L/r_T)^2}{1530 \times 10^3 \times C_b}\right] F_y$$

$$F_b = \left[\frac{2}{3} - \frac{36\,(91.22)^2}{1530 \times 10^3 \times 1.13}\right] 36$$

$F_b = 17.76$ ksi allowable

The beam of self weight $= \frac{62\ lb}{ft} = 0.062\ k/ft$

$$M = \frac{wL^2}{8} = \frac{1}{8}(0.062)(52)^2$$

$M = 20.95$ K ft

Total $M = 156 + 20.95$

$m = 176.95$

$$f_b = \frac{M}{S_x} \Rightarrow \frac{176.95 \times 12}{131} = 16.2\ ksi$$

$f_b < F_b$

Use W24 X 62.